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Patterns in dental enamel hypoplasia by sex and age at death in two archaeological populations

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ABSTRACT

Aims: Levels of enamel hypoplasia in past populations are frequently used to study health. However, few studies have looked at patterning in the occurrence of different types of hypoplasia. In this pilot study, skeletal remains from an Iron Age tomb at Pella in Jordan were analysed for the presence of linear and pit enamel hypoplasia, to investigate enamel hypoplasia aetiology by comparison of the results obtained for adults and juveniles, and females and males.

Methods and results: The proportion of individuals with enamel hypoplasia was determined for males and females and for adults and juveniles using the F.D.I. Developmental Defects of Enamel (DDE) Index. Although males and females had a similar percentage of individuals affected, females had a higher prevalence of enamel hypoplasia per tooth than males. Adults had a higher prevalence of enamel hypoplasia than juveniles. In particular, adults had a higher prevalence of linear enamel hypoplasias and pit enamel hypoplasia arrays, but a similar prevalence of single pit enamel hypoplasia when both the permanent and deciduous dentitions were considered. These differences were largely due to different patterns and frequencies of enamel hypoplasia in deciduous teeth compared to permanent teeth.

Conclusions: The different patterns of occurrence of the various forms of hypoplasia observed in this study imply that single pits may have a different aetiology to linear enamel hypoplasias and pit arrays. By investigating similar patterns in other archaeological populations, we may develop a better understanding of the specific causes of particular types of enamel hypoplasia, and may be able to more meaningfully interpret enamel hypoplasia data from past populations.

1. Introduction

The frequency of enamel hypoplasia in archaeological populations is used to study health in the past. Enamel hypoplasia frequencies are commonly compared to those in modern populations, to determine the relative childhood health status of a population.[1,2] However, the aetiology of enamel hypoplasia is multifactorial with many identified genetic and environmental factors contributing to its formation,[3] rendering meaningful interpretation of their occurrence in archaeological populations problematic.

Epidemiological studies of enamel hypoplasia in modern populations have indicated the wide range of types of environmental factors related to enamel hypoplasia. Enamel

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hypoplasia occurrence has been linked to socioeconomic status,[1,4–6] malnutrition,[7–11] infectious diseases including dental caries,[7,11–13] weaning[14,15], fluoride levels[16,17] and premature birth.[18,19] Depending upon the severity of the stress, the extent to which the individual is exposed to this stress and the genetic susceptibility of the individual to enamel hypoplasia formation,[20] the individual may not experience growth disruption, or may succumb to the stressor and die. Neither of these scenarios would produce an enamel hypoplasia, even though other individuals experiencing the same stressor may suffer from growth disruption, resulting in the formation of an enamel hypoplasia.

Some researchers have suggested that there is not a strong link between the duration of the stressful event and the absolute size of the enamel hypoplasia at the individual level and that the duration of the insult can be best determined by counting the perikymata within the defect.[21,22] However, examination of perikymata counts within hypoplastic defects have indicated that the average enamel defect width is a more accurate measure of the duration of physiological disturbance when determined at the population level.[23]

Enamel hypoplasias can appear on the tooth in three different forms: linear, pit or planar. Linear enamel hypoplasias (LEHs) are defined as grooves on the enamel surface. LEHs tend to run horizontally, parallel to the cementoenamel junction, and resemble exaggerated perikymata. In contrast, pit enamel hypoplasias are well-defined pits in the enamel surface. These can appear as a linear array, a non-linear array or single, isolated pits. In contrast, planar enamel hypoplasia results from the absence of whole sections of enamel from the tooth. The existence of these three forms of enamel hypoplasia is well established, but while the causes of LEH are relatively well understood, the aetiology of pit enamel hypoplastic defects is not yet fully known.[21] LEH is assumed to be primarily due to generalized systemic stress, due to infectious disease, nutritional stress or a combination of the two, with planar enamel hypoplasia being an extreme case of LEH.[24] In contrast, pit enamel hypoplasias have sometimes been linked with episodes of localised trauma[25]. However, the evidence for such a split in aetiology in human teeth is limited at present.

This paper reports the findings of a pilot study which sought to compare the occurrence of enamel hypoplasia between males and females and between adults and juveniles from an archaeological population, with a relatively high overall prevalence of hypoplasia[26] in order to investigate possible aetiological factors.

2. Methods

The skeletons examined in this study consist of the skeletal remains of Tomb 89 from the Early Iron Age (1100–900 BC) site of Pella in Jordan. Pella is located in the foothills of the Transjordanian Plateau (Fig. 1), close to the modern village of Tabaqat Fahl on the eastern side of the Jordan Valley,[27] and was occupied from approximately 8000 BC until AD 1600.[28] At this time, Pella was a relatively small agricultural settlement, and its population is estimated at around 500 individuals (Bourke, pers. comm.). The population appears to have been relatively insular in the Early Iron Age, with a distinctive pottery style at the site that is unlike those of neighbouring settlements.[29]

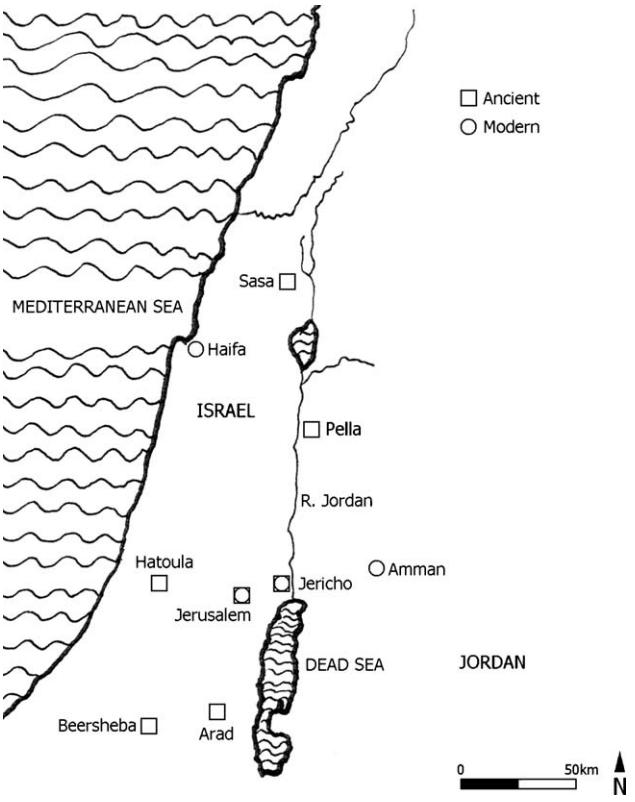

Fig. 1 – The location of Pella within the Levant.

Tomb 89 was excavated in 1987 by the University of Sydney School of Archaeology (Bourke, pers. comm.). The grave goods within the tomb suggest that the individuals buried within the tomb represent a range of social classes, although the absence of rich material culture suggests the absence of elites within the tomb. Analysis of the palaeopathology of the individuals from this tomb indicated that the population were generally healthy.[30] However, the prevalence of enamel hypoplasia within this population is high, suggesting that general living conditions at the site were poor.[26]

Although the skeletal remains within the tomb were disarticulated and often fragmentary, it was possible to identify the skeletal remains belonging to 78 individuals within the tomb. Because of taphonomic changes, it was not possible to determine in any detail the order of burial of the individuals within the tomb or the status of particular individuals within the tomb. The population analysed has a relatively low rate of dental caries and few cases of severe attrition.

All hypoplastic defects of the enamel observed were recorded, regardless of whether they were associated with hypoplastic lesions on other teeth of the dentition, to allow mapping of hypoplastic defects throughout the dentition. However, for the analysis of prevalences of hypoplasia per individual, a multiple-tooth approach was used. While this approach is more complex than utilizing a single tooth type, it allows easier identification of enamel hypoplastic defects regardless of aetiology.[31]